

1 WHAT IS CLAIMED IS:

1. An Fe-base in-situ composite alloy, castable into 3-dimensional bulk objects, wherein the cast alloy comprises:

5 a matrix comprising one or both of a nano-crystalline phase and an amorphous phase; a face-centered cubic crystalline phase, and an Fe content more than 60 atomic percent.

10 2. The alloy as in claim 1, wherein the matrix is substantially amorphous phase.

15 3. The alloy as in claim 1, wherein the matrix is substantially nano-crystalline phase.

15 4. The alloy as in claim 1, wherein the volume percentage of the amorphous phase is in the range of from 5% up to 70 %.

20 5. The alloy as in claim 1, wherein the volume percentage of the matrix is in the range of from 20 % up to 60 %.

20 6. The alloy as in claim 1, wherein the face-centered cubic crystalline phase is in the form of dendrites.

25 7. The alloy as in claim 1, wherein the alloy is substantially formed by Fe, (Mn, Co, Ni , Cu) (C, Si, B, P, Al), , wherein the Fe content is from 60 to 75 atomic percentage, the total of (Mn, Co, Ni , Cu) is in the range of from 5 to 25 atomic percentage, and the total of (C, Si, B, P, Al) is in the range of from 8 to 20 atomic percentage.

30 8. The alloy as in claim 7, wherein the content of (C, Si, B, P, Al) is higher in the matrix than in the face-centered cubic crystalline phase.

30 9. The alloy as in claim 7, wherein the alloy is substantially formed by Fe (Mn, Co, Ni , Cu) (C, Si), , wherein the Fe content is from 60 to 75 atomic percentage, the total of (Mn, Co, Ni , Cu) is in the range of from 5 to 25 atomic percentage, and the total of (C, Si) is in the range of from 8 to 20 atomic percentage, and the Si to C ratio is less than 0.5.

35 10. The alloy as in claim 7, wherein the alloy is substantially formed by Fe (Mn, Co, Ni , Cu) (C), , wherein the Fe content is from 60 to 75 atomic percentage, the total of

1 (Mn, Co, Ni , Cu) is in the range of from 5 to 25 atomic percentage, and the content of C, is
in the range of from 8 to 20 atomic percentage.

5 11. The alloy as in claim 10, wherein the content of C is higher in the matrix than
in the face-centered cubic crystalline phase.

12. The alloy as in claim 1, further comprising a Cr content up to 8 atomic
percent.

10 13. The alloy as in claim 7, further comprising a total of (Cr, Mo) content up to 8
atomic percent.

14. The alloy as in claim 1, further comprising a Y content up to 3 atomic percent.

15 15. The alloy as in claim 7, further comprising a Y content up to 3 atomic percent.

16. The in-situ composite alloy as in claim 6, wherein the particle size of the face-
centered cubic crystalline phase is in the range of 3 to 30 microns.

20 17. An Fe-base in-situ composite alloy comprising:
a matrix comprising one or both of a nano-crystalline phase and an amorphous phase;
a face-centered cubic crystalline phase;
an Fe content in the range of 65% to 70%;
a three dimensional shape having a measurement of at least 0.5 mm in each
25 dimension; and
a flow-stress level of at least about 2.0 GPa.

18. The in-situ composite alloy as in claim 17, wherein the particle size of the
face-centered cubic crystalline phase is in the range of 1 to 100 microns.

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